

Invasive Species of Public Health Concern in Arizona




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Invasive Species: Broad Definition

Invasive species can be plants, animals, or arthropods, etc.

- ◆ non-native (or alien) to the ecosystem under consideration and
 - ◆ whose introduction causes or is likely to cause economic or environmental harm or harm to human or animal health.
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- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, extending from the right edge towards the center.

Examples of Invasive Species



- ◆ Source: Az Invasive Species Advisory Council (AISAC) Webpage

Invasive Species: Public Health Concern for Arizona

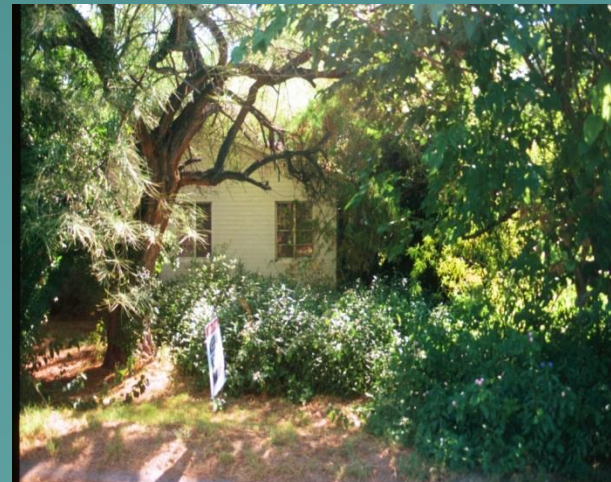
Animals or arthropods that:

- ◆ were not native to Arizona, and
- ◆ may pose a threat to human health as either a vector and/or reservoir of disease.
- ◆ Note: this definition does not include species that are capable of envenomation

Factors Affecting New Species Invasion


Human caused interventions

- ◆ International travel – people & pets
- ◆ International trade
- ◆ Exotic pet trade
- ◆ Habitat alteration
- ◆ Micro-climate alteration



Factors Influencing New Species Invasion

Natural/non-human events

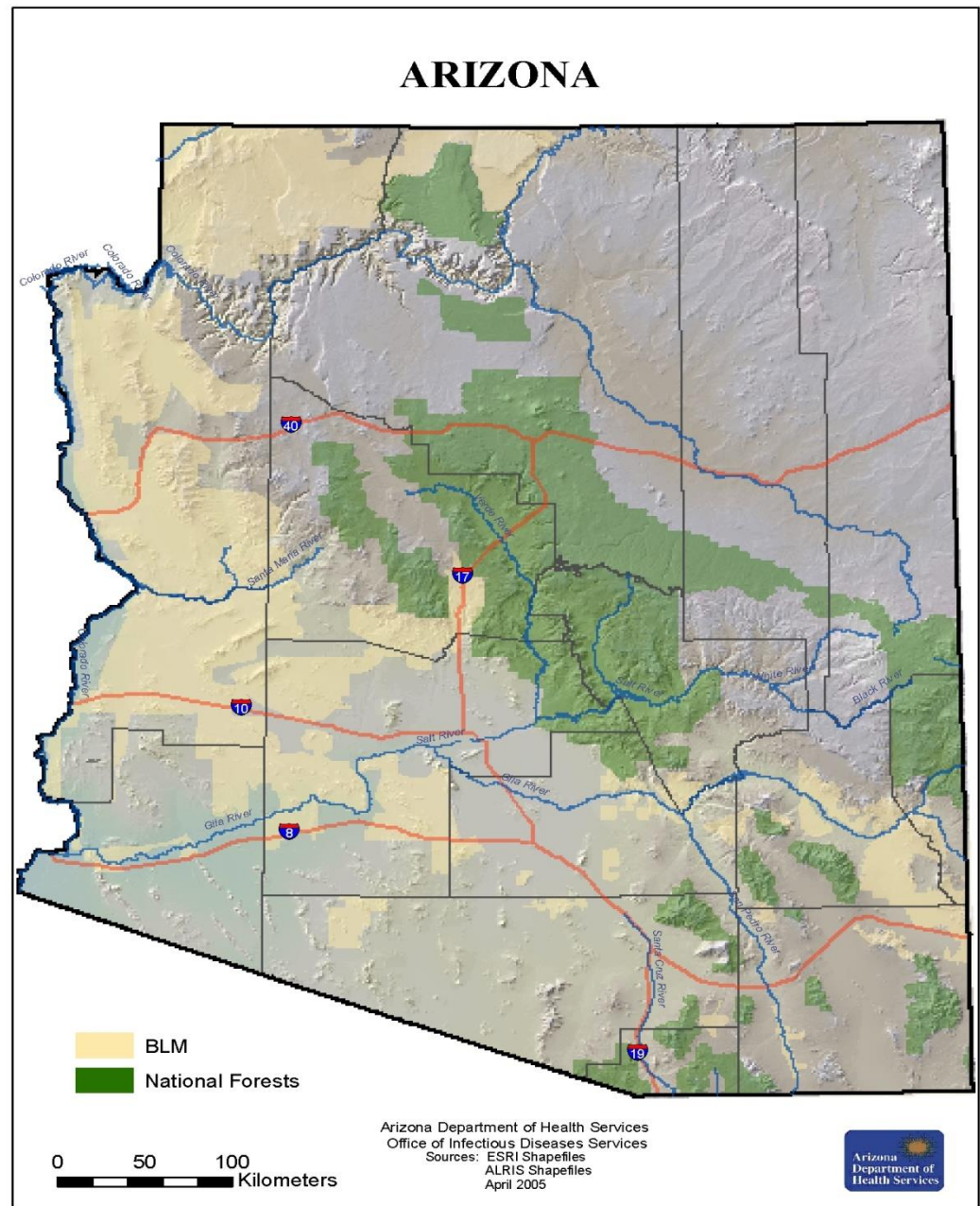
- ◆ Climate change
 - ◆ Extreme weather events
 - ◆ Natural species migrations
 - ◆ Natural species expansions
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- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, extending from the right edge towards the center.

Of Concern

- ◆ Introduced species may not be detected for an extended period of time. New species may be well established and widespread by the time we know about it making eradication nearly impossible (e.g. *Ae. aegypti*, roof rats).

Of Concern

Arizona's Habitat Diversity



Invasive Species of Public Health Concern in Arizona

- ◆ *Rosy faced love birds*
- ◆ *Aedes aegypti*
- ◆ *Ae albopictus* ?
- ◆ *Culex erraticus* ?
- ◆ *Roof Rats* ?



Rosy Faced Love Birds

- ◆ Species: *Agapornis rosiecollis*
- ◆ A.k.a. *Peach faced love birds*
- ◆ *Small colorful parrots native to southwestern Africa*
- ◆ *Popular in the pet trade*
- ◆ *U.S. birds captive bred*



Rosy Faced Love Birds (RFLBs)


- ◆ Adapted to drier climates
- ◆ Can rear up to three broods per year with 4-5 eggs per clutch
- ◆ Very social w/ large flocks
- ◆ Very noisy
- ◆ Life span – 15-25 years

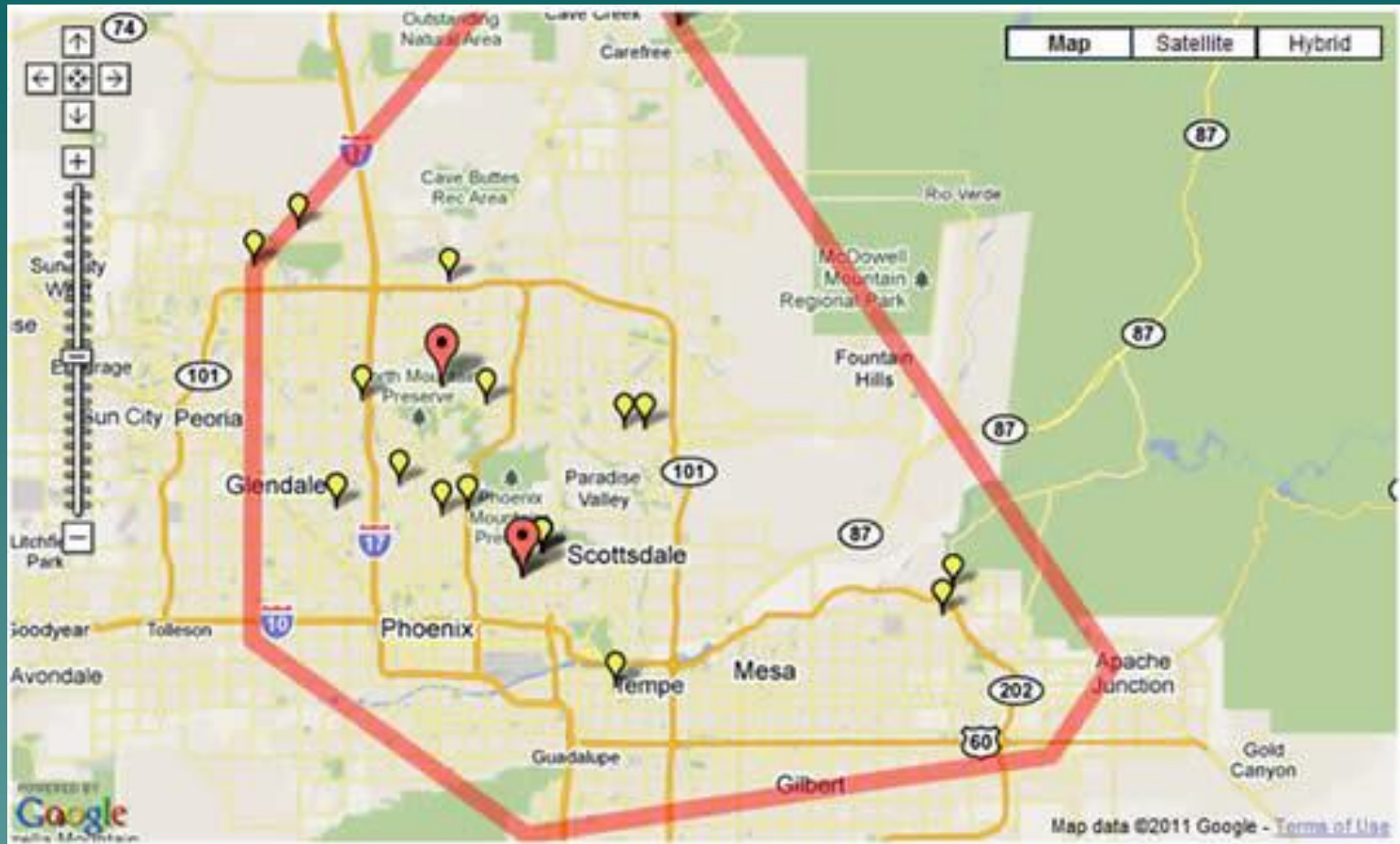


RFLBs in Maricopa County

- ◆ Phoenix is the only known feral population of RFLBs in the U.S.
- ◆ Hypothesis: 1980's release of 15-20 pet birds from an aviary in the East Valley. First seen in East Mesa/AJ in 1987.
- ◆ For 20+ years RFLB populations have been multiplying & expanding
- ◆ MC RFLBs are descendants of domestic "pet shop" stock
- ◆ Rare sightings have been seen in Tucson but not believed to be established

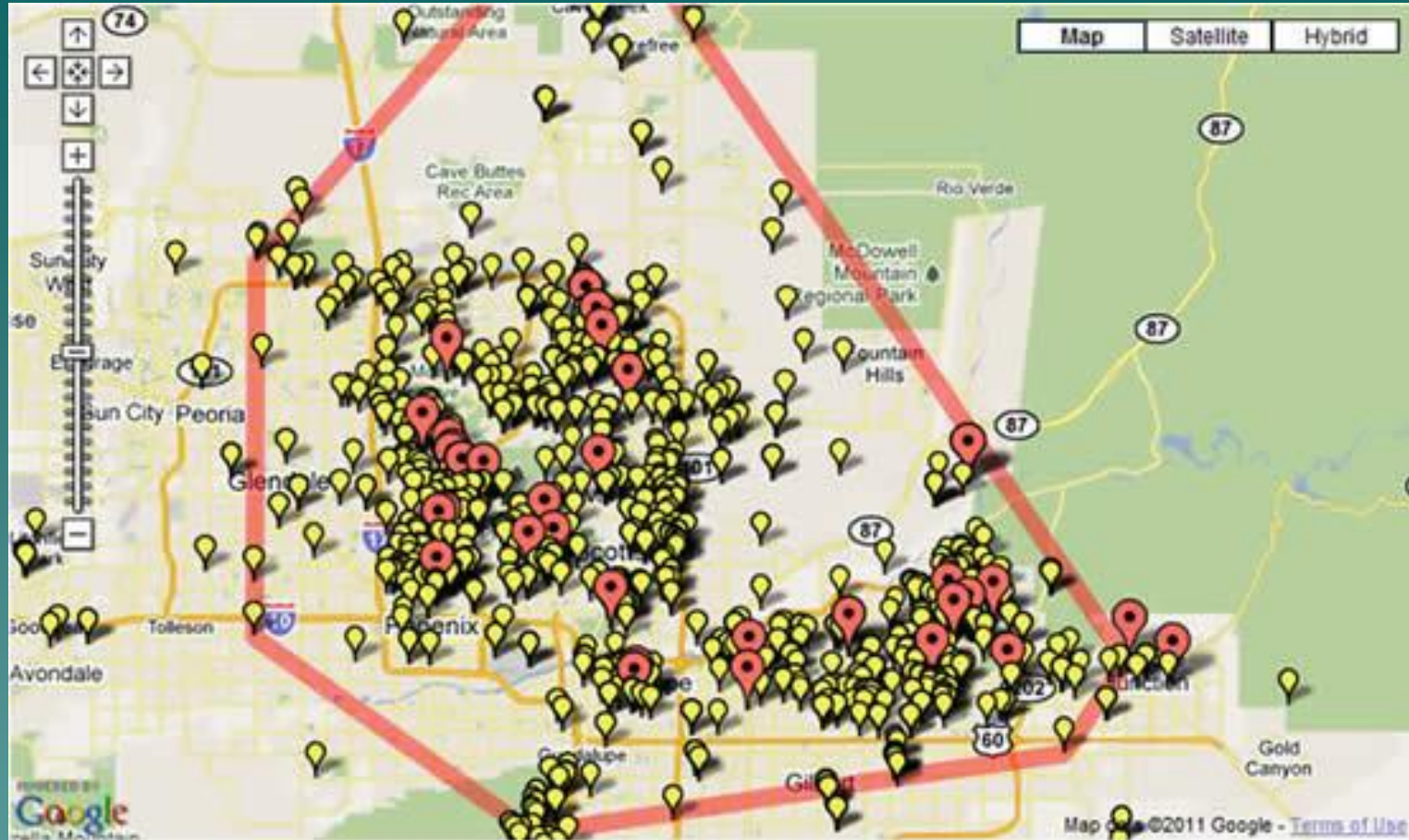
RFLBs in Maricopa County

- ◆ Nest in un-trimmed palm fronds (especially date palms) and hollow saguaro cavities
 - ◆ Mostly live in residential areas – especially older neighborhoods with tall trees
 - ◆ Food: backyard bird feeders, palm fruits, cactus fruits, mesquite & palo verde seeds, etc.
 - ◆ RFLBs have no natural predators in MC
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- A stylized, layered mountain range graphic in shades of teal and blue, located in the bottom right corner of the slide.



Greater Phoenix Area map (reproduced from Mirror-Pole website) of reported Rosy-faced Lovebird locations in 1999-2005. Yellow balloons indicate sightings of 1-10 individuals and red balloons = flocks of >10 individuals.

Source: www.azfo.org/journal/Rosy-facedLovebird2011.html



Greater Phoenix Area map (reproduced from Mirror-Pole website) of reported Rosy-faced Lovebird locations in 1999-2010. The red border shows the initial known boundary of the species

Source: www.azfo.org/journal/Rosy-facedLovebird2011.html

Bird Die Off Investigation

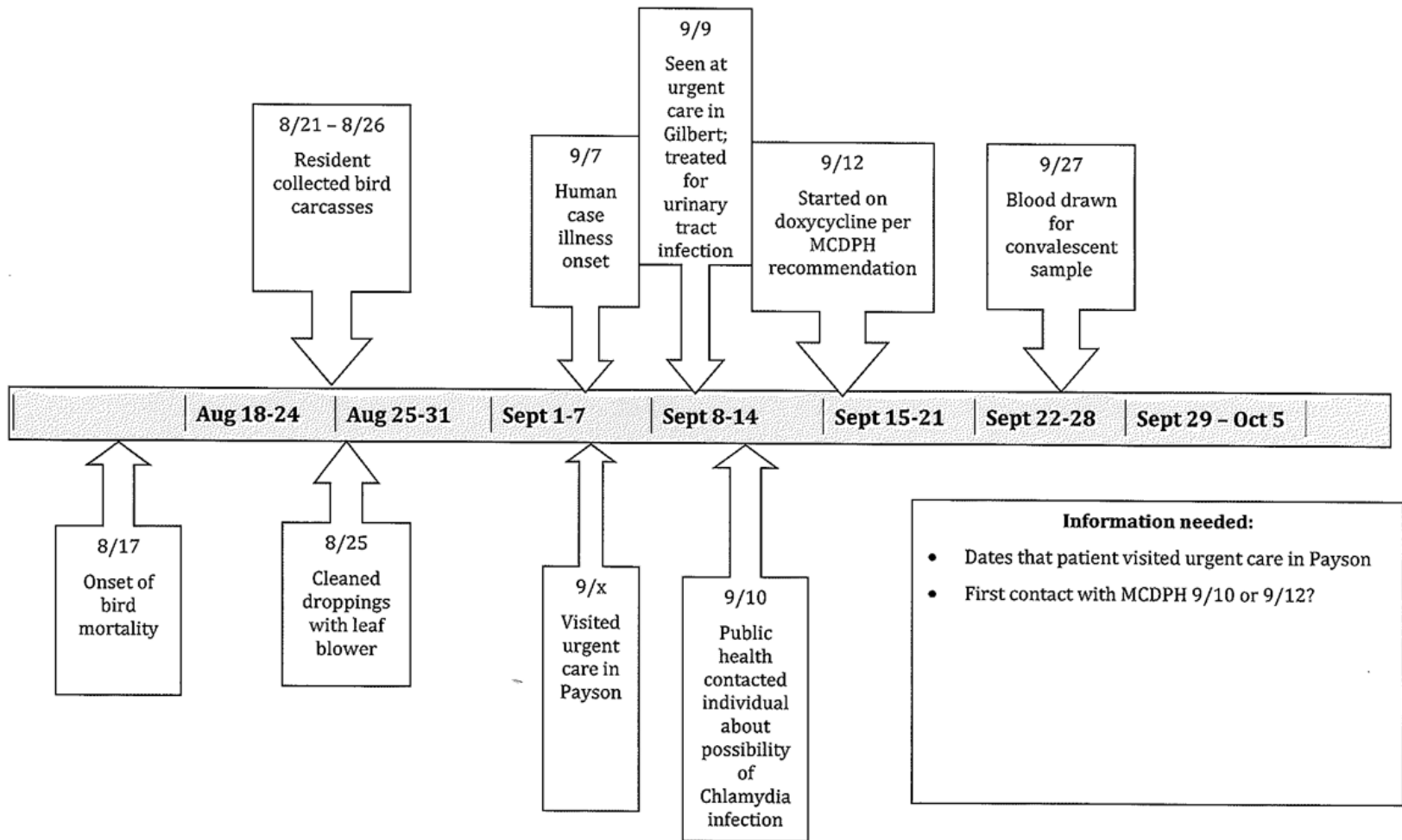
Multi-Agency: 'One Health'

- ◆ Prior to 2013, there had been no known adverse impacts from RFLBs
- ◆ Late August 2013, Arizona Game and Fish Department (AZGFD) was notified of die-off of ~30 lovebirds in local community in the East Valley
- ◆ Other lovebirds in area showing signs of illness; no other species affected
- ◆ Bird carcasses sent to USGS National Wildlife Health Center (NWHC) for testing

Human Case Investigation

- ◆ AZGFD was called by the same person (adult female) that reported the die-off - she had developed high fever and respiratory disease
- ◆ ~2 weeks after bird mortality event
- ◆ Public health was notified by AzGFD
- ◆ PH investigation: patient interview revealed that she cleaned-up bird droppings from porch w/ air blower

Psittacosis Timeline



Laboratory Results

- ◆ Lovebirds found to be PCR positive for *Chlamydophila psittaci*
 - Negative for all other pathogens
- ◆ Bacteria and characteristic lesions identified in liver
- ◆ Single convalescent blood sample was collected from the human case patient 20 days after initial clinical signs
- ◆ Results tested positive for *Chlamydia* IgG at two different laboratories

Background

- ◆ *Chlamydophila psittaci*
 - Gram negative, coccoid, obligate intracellular bacterium
 - Avian Chlamydiosis in birds
 - A.k.a. 'Ornithosis' & 'Parrot Fever'
 - Zoonotic agent → human Psittacosis
 - ◆ Infection is acquired by inhaling dried droppings or secretions from infected birds.
 - ◆ The incubation period is 5 to 19 days.
 - ◆ Pet birds and poultry are most frequently involved in transmission to humans
 - ◆ Human psittacosis is under dx & under reported

Chlamydia infections in birds occur worldwide and infect a wide variety of species. Different serovars have been isolated from different bird groups. Different serovars show differences in virulence among different hosts.


Serovar	Bird Source
A	Parrot Order
B	Pigeons, Turkeys
C	Ducks, Swans, Geese
D	Turkeys, Egrets
E	Pigeons, Ratites, Turkeys
F	Parakeets
WC	Bovine (Mammal)
M56	Muskrat, Snowshoe Hare

Discussion


2013 investigations = strong case for psittacosis transmission from feral RFLBs

- ◆ *C. psittaci* confirmed as cause of RFLB mortality
- ◆ Human case had significant exposure to aerosolized bird droppings at the same site as bird die-off
- ◆ Human case had onset of psittacosis like sx within incubation period
- ◆ Human case tested positive w/ high IgG titers to *Chlamydia*

Discussion

- ◆ Risk for psittacosis transmission to humans is highest for indoor pet birds due to more intimate exposures in confined spaces
 - ◆ Risk is lower in outdoor open air environment
 - ◆ 2013 investigation demonstrated that infected outdoor feral RFLBs do pose a disease risk to humans
 - ◆ How likely is it that may occur again?
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- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the text of the last bullet point.

Discussion

- ◆ LOTS!!! of people feed birds
 - ◆ Bird feeders attract and concentrate lots of birds
 - ◆ Congregating birds share pathogens
 - ◆ RFLBs are very popular among people feeding birds
 - ◆ Lots of birds = lots of droppings
 - ◆ Sooner or later, someone has to clean-up the mess
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Limitations of the Investigation

- ◆ Acute blood samples were never collected for the case patient at either of two UCs
- ◆ Dx of psittacosis was based on a single convalescent blood
- ◆ Without paired sera, you cannot confirm that there was recent infection w/ psittacosis (case = 'probable')
- ◆ Serologic tests for psittacosis cross react with other *Chlamydias*, such as *C. pneumoniae* and *C. trachomatis*

Next Steps

- ◆ Perform serovar testing of the dead RFLBs to see what direction the infection is coming from:
RFLBs $\leftarrow ? \rightarrow$ wild bird species
- ◆ Do additional *Chlamydia* testing of RFLBs in new locations around MC to see how common & widespread
- ◆ Do outreach to the medical & veterinary medical community to increase awareness & enhance surveillance
- ◆ Do prevention outreach to the public ?

Feral RFLBs: Is Your County Next?



Invasive *Aedes* Mosquitoes



Aedes aegypti

Aedes albopictus

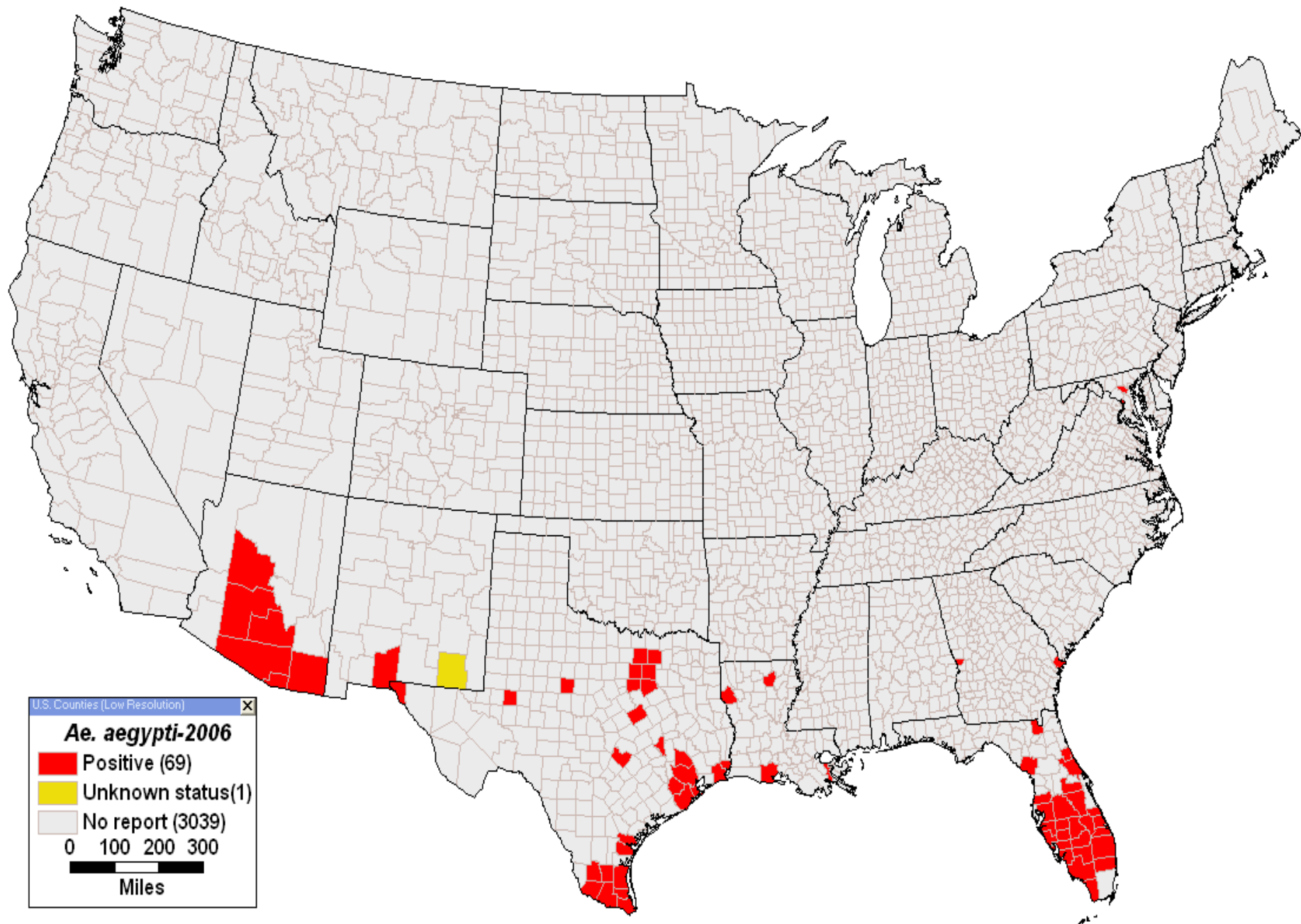
Florida Medical Entomology Laboratory
©1999 UNIVERSITY OF FLORIDA



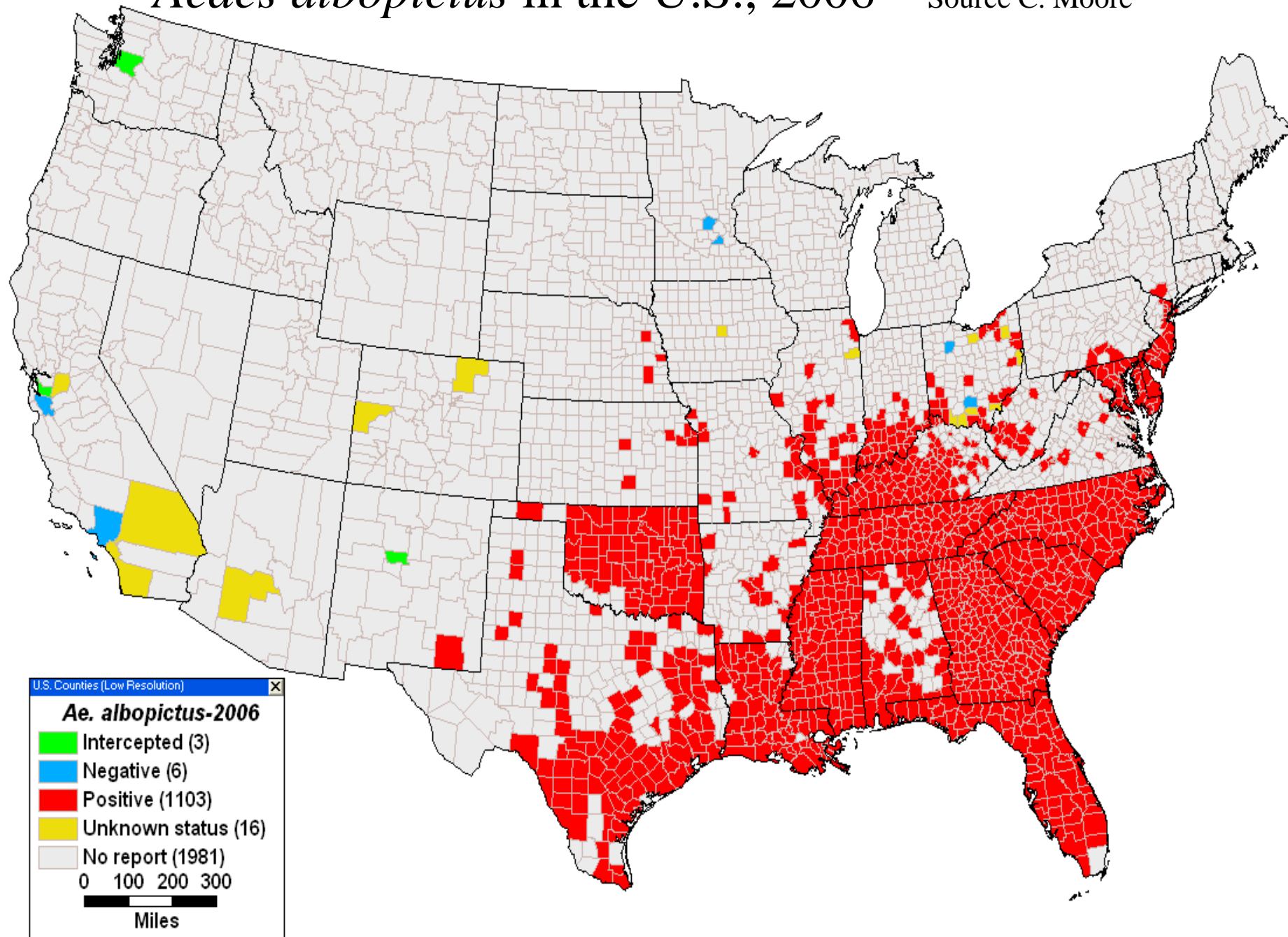
Aedes species comparison

- ◆ *Aedes albopictus*
 - ◆ container breeder
 - ◆ urban environment
 - ◆ multi-host – humans, other mammals, birds
 - ◆ vector: **dengue**, VEE, WNV, SLE, EEE, JE, WEE, **chikungunya**
 - ◆ tropical-temperate
 - ◆ more aggressive biter!
 - ◆ not in Arizona (yet)
 - ◆ more cold tolerant
- ◆ *Aedes aegypti*
 - ◆ container breeder
 - ◆ urban environment
 - ◆ single host/human
 - ◆ vector: **Dengue**, yellow fever, **chikungunya**
 - ◆ tropical/subtropical
 - ◆ ankle biter – daytime
 - ◆ already widespread – southern & central AZ
 - ◆ more “dry-tolerant”

Aedes aegypti in the U.S., 2006 — Source C. Moore



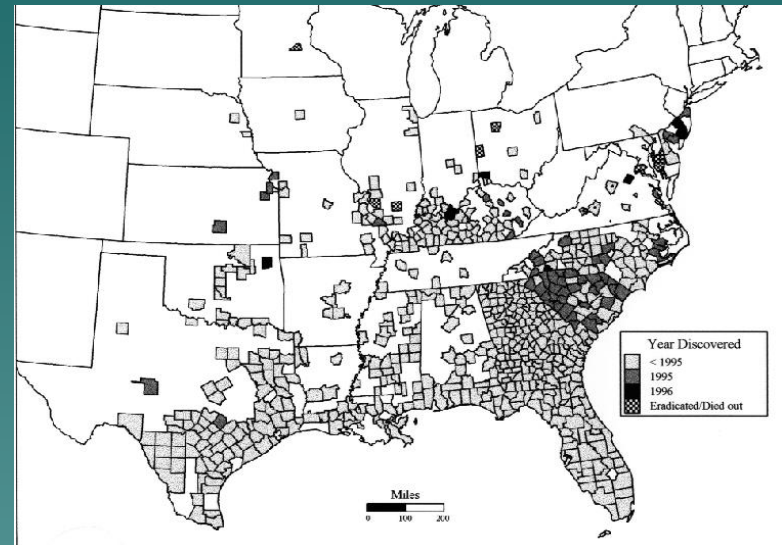
Aedes albopictus in the U.S., 2006 — Source C. Moore




Ae. albopictus – sources of introduction

- ◆ Exotic plants business
 - “lucky” bamboo
 - volcano plants
 - banana plants
- ◆ New/recycled tires
- ◆ Yard clutter - families moving state-to-state

“It’s re-introduction is inevitable.”

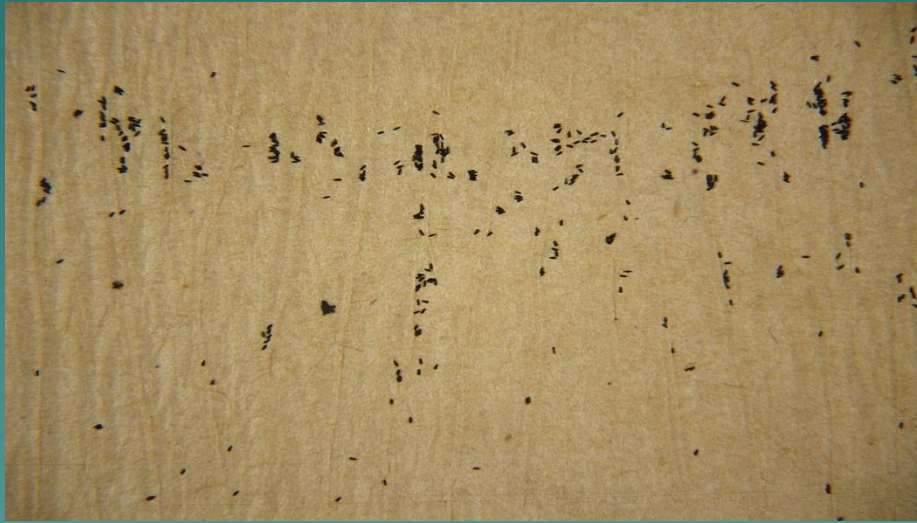


Asian Tiger Mosquitoes Introductions into Arizona

- ◆ 2002 – Pima County /Tucson - introduced via banana plants shipped from Florida – purchased over the internet.
 - ◆ 2006 – Maricopa County / Chandler & Awhatukee - volcano plants shipped from Texas – purchased over the internet.
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- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the bottom edge of the text area.

Asian Tiger Mosquito Introduction

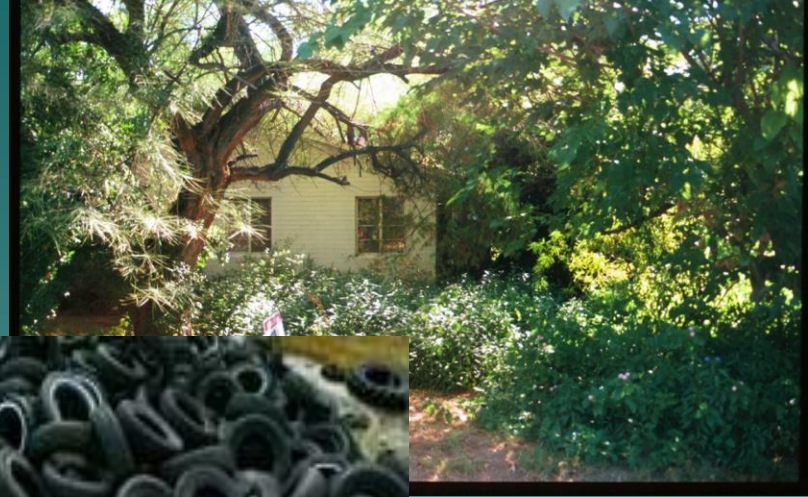
Mosquito Eggs



Volcano Plant



Can Asian Tiger Mosquitoes Survive in Desert Southwest?




Dengue



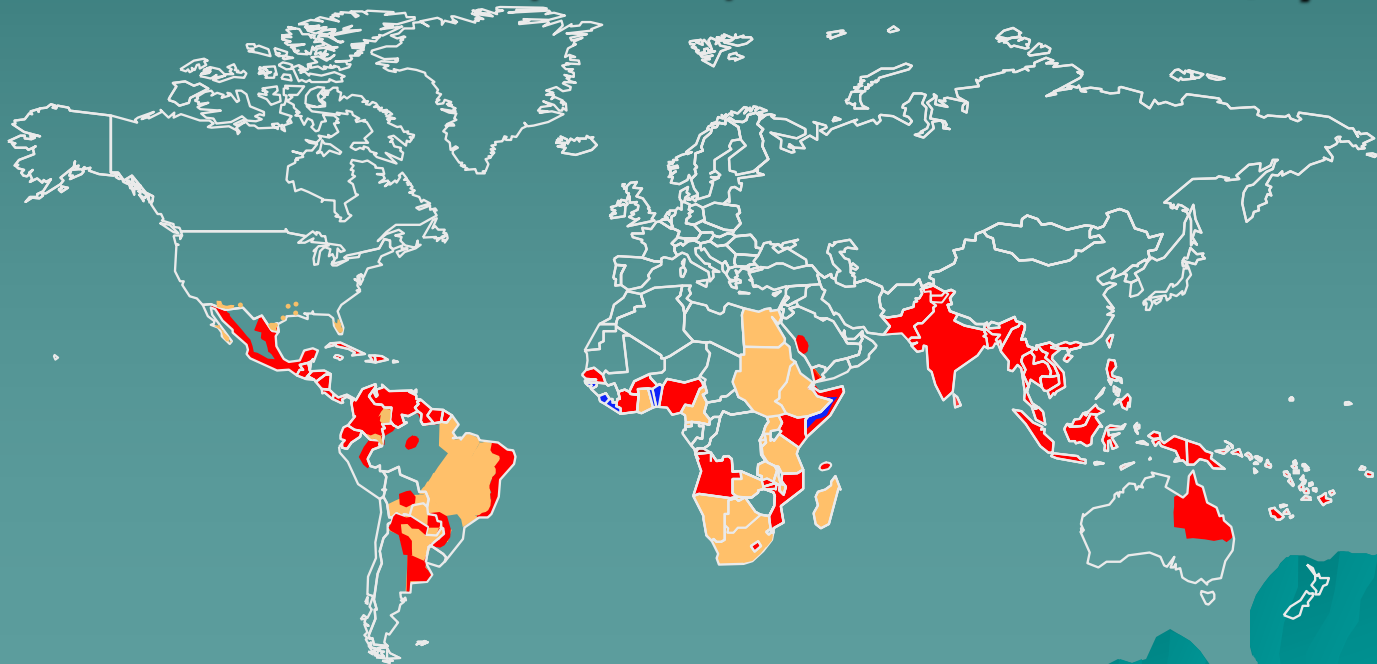
Dengue is AZ's #1 threat for diseases vectored by *Aedes aegypti*

Dengue


- ◆ Genus Flavivirus – single strand RNA virus
 - ◆ 4 Serotypes (DEN-1,2,3,4)
 - ◆ Most infections = asymptomatic or mild
 - ◆ Increasing trend for hyperendemicity.
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- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, adding a decorative element to the background.

Dengue Occurrence

- ◆ Worldwide – 100+ countries – mostly tropical & sub-tropical regions
- ◆ Estimated 50,000,000+ cases/year



Clinical Sx – Classic Dengue

- ◆ Sudden onset
 - ◆ Fever (2-7 days, sometimes biphasic)
 - ◆ Headache & retro-orbital pain
 - ◆ Muscle & joint pain
 - ◆ Anorexia/nausea/vomiting
 - ◆ Rash
 - ◆ Minor hemorrhagic manifestations are possible (nose bleeds, bloodshot eyes, etc.)
 - ◆ Recovery – prolonged fatigue & depression
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Chikungunya

- ◆ Togaviridae, Genus *Alphavirus*
- ◆ Principal vectors = *Aedes aegypti* & *Ae. albopictus*
- ◆ Reservoir = humans – infection can result in very high viremias before & during early illness.
- ◆ Makonde word meaning “bent / contorted” – referring to the stooped postures of patients – due to severe joint pain.
- ◆ First described in 1955 following outbreaks on the Makonde Plateau between Mozambique & Tanganyika.

Chikungunya Symptoms

- ◆ Similar to dengue
- ◆ Sudden onset of fever
- ◆ Severe polyarthralgia (joint pain) & myalgia (muscle pain) resulting in stooped posture
- ◆ Maculopapular rash
- ◆ Headache, fatigue, nausea
- ◆ Long lasting disability due to persistent arthralgia -“crippling pain”

Chikungunya

- ◆ Evidence of point mutation which altered a single amino acid in virus envelope protein
- ◆ Enhance infectivity of mosquito vectors – allowed virus to replicate easily in midgut
- ◆ 100-X increase in virus conc. in salivary glands of the mosquito.
- ◆ Possible increase in virulence as evidenced by ↑ severity & persistence of sx
- ◆ NOTE: 72-97% of infections = symptomatic
“If you get Chik - You get sick!”


Chikungunya: Recent Events

- ◆ 2006 - Indian Ocean Region – Seychelles, Mauritius, Comoros, Re'union – favorite tourist destinations for Europeans
- ◆ Estimated 300,000+/- cases
- ◆ India – 2006 - 1.39 million cases
- ◆ 2007 – spread to Malaysia & Indonesia
- ◆ European travelers – France, Germany, Italy, etc. – imported cases↑ (e.g. 800 cases in France).
- ◆ Outbreak in Italy 2007 – local transmission via *Ae. albopictus* mosquitoes. 200+ cases reported.
- ◆ Several dozen imported cases → U.S.

Western Indian Ocean




Chikungunya in the Western Hemisphere

- ◆ Chikungunya arrived in the Caribbean – 1st cases seen on St. Martin in late 2013.
 - ◆ The chikungunya virus is of the Asian Genotype and is believed to have come from the Philippines or China.
 - ◆ 4+ months later – estimated **35,500+** cases on many Caribbean islands.
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- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the text of the third bullet point.

Chikungunya in the Caribbean



Chikungunya in the West

- ◆ Chances of Chik cases & possibly OBs in the U.S. in 2014 and beyond is high
 - ◆ U.S. - 100% naïve population
 - ◆ *Aedes* vectors thriving many states
 - ◆ Lots of travelers to/from Chik zones
 - ◆ Lots of potential for exposure (e.g. island hopping Caribbean cruises)
 - ◆ Infections produce high viremias w/ long duration. Infected travelers = excellent reservoirs.
 - ◆ Stay tuned.....
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- A stylized, dark teal mountain range graphic is located in the bottom right corner of the slide, partially overlapping the text of the last bullet point.

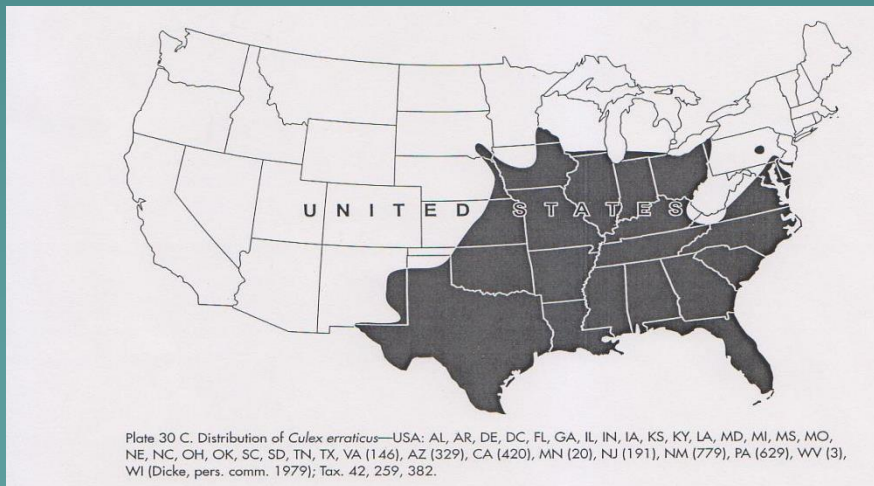
The Case of Culex erraticus - Yuma



Source: Chris Sumner – Yuma Pest
Abatement District

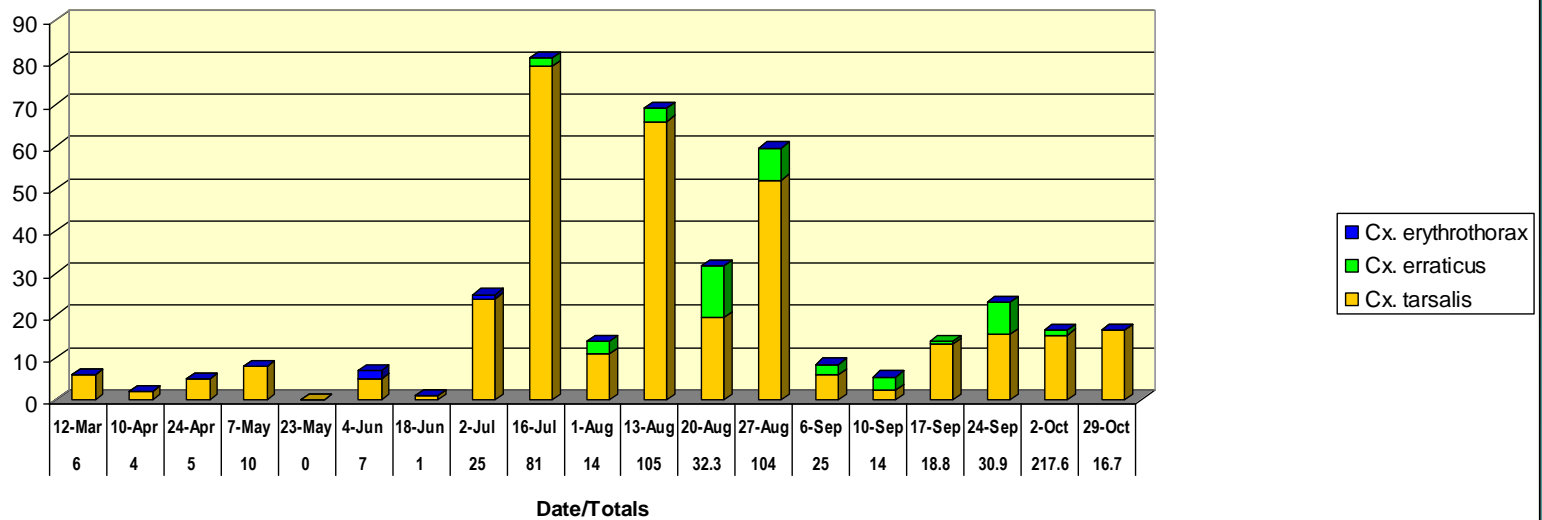
Cx. erraticus

- ◆ *Cx erraticus* is small dark mosquito
- ◆ Distribution is eastern U.S.
- ◆ No collections in Yuma area until August 2004



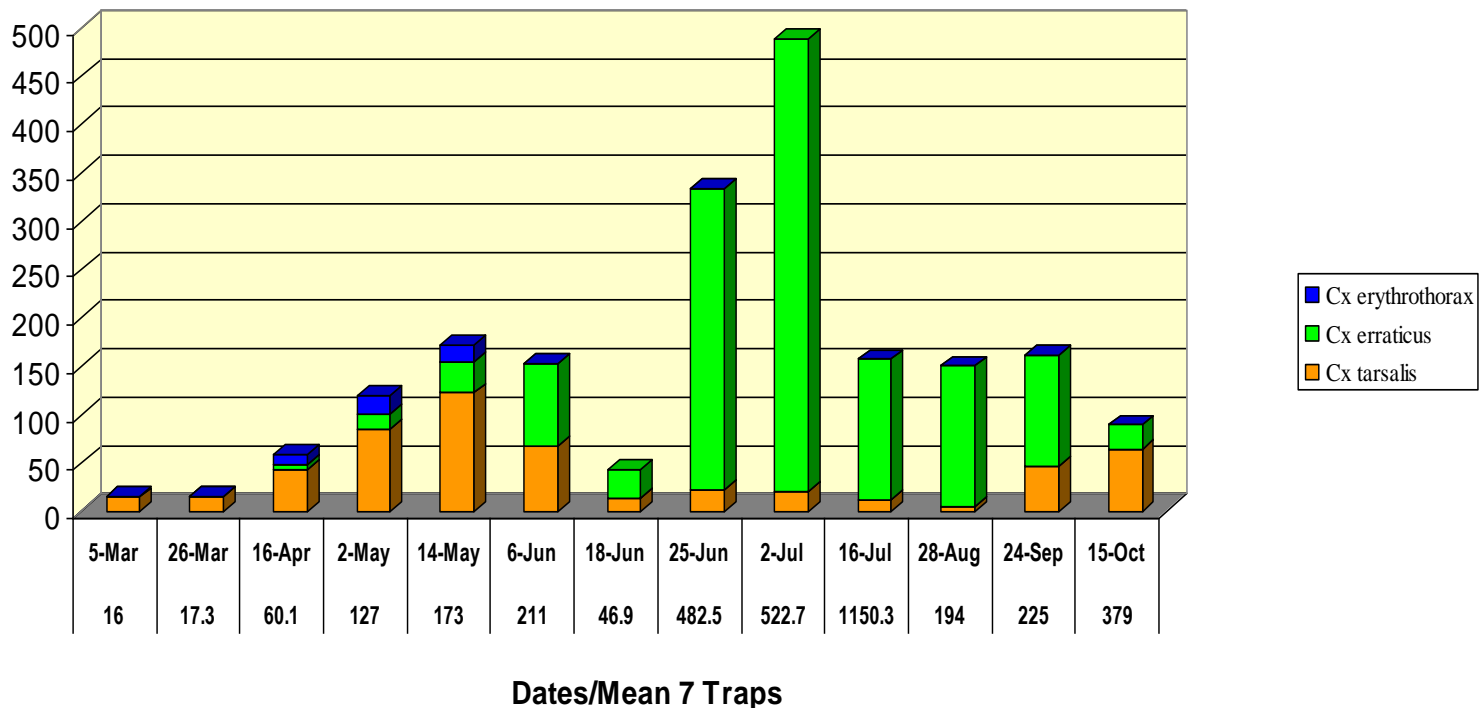
Cx. erraticus Abundance 2007

2007 YEW Species Composition



Cx. erraticus Abundance 2012

2012 YEW Species Composition



Cx erraticus Arizona Habitat?

- ◆ Open ponds and pools
- ◆ Contact with saltgrass or bermuda
- ◆ Shaded areas
- ◆ Not associated with dense emergent vegetation

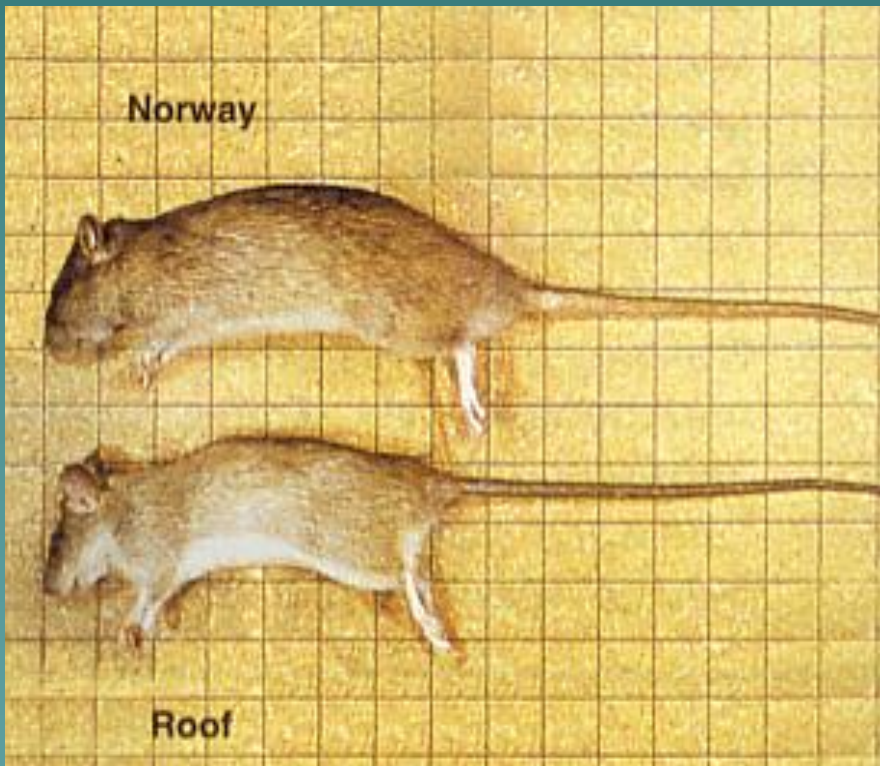


Culex erraticus – What is going on?

- ◆ Is habitat change/enhancement at YEW and other locations the reason for the dramatic increase in *Cx. erraticus*?
- ◆ Is *Cx. erraticus* outcompeting *Cx. tarsalis*?
- ◆ Or, are vector control activities more effective on *Cx. tarsalis*, thus favoring *Cx. erraticus*?
- ◆ *Cx. erraticus* appears to have low vector potential for WNV?
- ◆ Could *Cx. erraticus* be a vector for other arboviruses?

What about Rats?

- ◆ Roof Rats: *Rattus rattus*
- ◆ Norway Rats: *R. norvegicus*



Rat-borne Diseases

- ◆ *Plague*
- ◆ *Leptospirosis*
- ◆ *Rat-bite fever*
- ◆ *Salmonellosis*
- ◆ *Bites & infection*
- ◆ *Dermatophytoses (e.g. Trychophyton sp.)*



Other: damage to wiring, crops, etc.


Roof Rats

- ◆ Rats were well established before ID
- ◆ Attempts to control through baits did not succeed
- ◆ MCVC – has mapped data for county – clearly the rats are spreading in MC
- ◆ Disease testing @ State Lab – results = negative for hantavirus, plague and tularemia. At this time – there is no documentable PH risk for roof rats in MC.
- ◆ There is PH concern if roof rats show-up in other parts of Arizona – esp. northern AZ!
- ◆ NOTE: 1970s - roof rats in Globe, AZ

Conclusions

- ◆ There many invasive species in Arizona & the U.S.
- ◆ There is continued risk for new introductions
- ◆ Most new species introductions are caused by human activities
- ◆ Some, but not all, invasive species are detrimental, including some that carry and/or transmit diseases

Response – Invasive Species of PH Concern

- ◆ Communicate & Cooperate w/ veterinary, wildlife, agriculture, public health and environmental health partners - 'One Health'
 - ◆ Surveillance – collections /trapping
 - ◆ Consider laboratory testing
 - ◆ Mapping / monitoring
 - ◆ Outreach / Education
 - ◆ Source reduction & vector control
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